IoT Architecture and Communication Protocols used in Healthcare Monitoring System

Akash R

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1 Summary

Internet of Things (IoT) is regarding the development of the internet ahead of computers and smartphones to an entire series of environments, procedures, and other things. In today's modern era, we all have a shortage of time to take care of our parents who are very old, due to which they depend more on IoT-based new wearable sensors. Elderly people need more health monitoring so that we can quickly identify and cure, whatever side effects they have such as increased blood pressure, body temperature, heart disease, etc., by the doctors within the time.

Smart Healthcare is an intelligent infrastructure that transfers information with the help of an IoT system and also implements processing from cloud and fog computing. In various applications, we can use Health Care with IoT like, diagnosis and elderly treatment, health management and managing chronic diseases, disease avoidance and risk monitoring, smart hospitals, virtual assistants, reducing urgent situation waiting times, assisting drug research, etc

IoT Elements with Technology

- Identification
- Sensing
- Communication
- Computation
- Service
- Semantic

1.1 Overview of IoT Protocols and Architecture

We need internet to connect devices and we also need a set of laws to govern those connections. These laws are called as Protocols. Nowadays, we use

TCP/IP protocol suite for network communication. IoT protocols are an essential element of the IoT technology stack and without them, the hardware connected to it is useless. Because the IoT protocols only tell data exchange in a structured and meaningful way. Though the availability of present Internet communications is free and the biggest constraint for any IoT device even today is that it is too heavy and a power-consuming process for any IoT use case.

Constrained Application Protocol (CoAP) was designed to translate the HTTP model so that it could be used in restrictive devices and network environments. It establishes a secure network connection between endpoints.

Message Queuing Telemetry Transport (MQTT) is a lightweight publication/subscription type messaging protocol. MQTT's design is simple and lightweight, and it is specially designed for battery-powered devices, providing small power consumption for devices. It works over TCP, and it cannot be used with all types of IoT applications.

IoT architecture is divided into five layers

1. Business Layer
2. Application Layer
3. Middleware Layer
4. Network Layer
5. Perception Layer

The architecture of IoT in Health Care

1. Sensor
2. Connectivity
3. Data Analysis
4. Application Platform
5. Product Infrastructure

1.2 Applications of IoT in Health Care

IoT in the Health Care field provides applications that can be separated into two sections:
Single condition observation, e.g., Glucose level monitoring, electrocardiogram sensing, blood pressure sensing, body temperature sensing, oxygen value sensing

ii) Clustered condition observation, e.g., Rehabilitation management, medication system, wheelchair system.

Google Fit

Google Fit is a health tracking platform developed by Google for Android and Wear OS devices. It allows users to track their fitness activities, such as steps taken, distance traveled, and calories burned, and includes a variety of other features to help users manage their health and wellness. Google Fit can automatically track activities using the sensors in a user's device, and it can also integrate with other health and fitness apps to collect data from a variety of sources.

Finger Print Thermometer

It is a sensor-based application that takes a user's finger to detect body temperature and pressure. It recognizes the finger which we press on the display panel. These sensors can permit users to just place their finger on the screen and recognize the print, rather than on a button. Random networks of a hybrid nanostructure stand on ultra-long silver nanofibers, and fine silver nanowires are used to produce clear, flexible electrodes of this multitasking sensor array.

1.3 Protocols

ZigBee (IEEE 802.15.4)

The contribution of master–slave architecture [14], in IoT, plays a significant task. The slave node passes on the different data readings to the sub-master node with the help of ZigBee, which is a good protocol for small distance communication, followed by the sub-master node, send the data which was received from the slave node to the master node, which is at a much greater distance and here sometimes due to lack of cellular network, therefore, LoRawan protocol has been used.

Here, we can see that both Zigbee and nRF are designed for small-distance communication and the data rate of ZigBee is 250 kbit/s.

CoAP

The Constrained Application Protocol (CoAP) is a web transfer protocol that is used for constrained nodes within constrained networks, which is having low bandwidth and low availability. It is similar to HTTP protocol. CoAP is a reliable and effective application protocol.

CoAP is not good in congestion control mechanism and having poor interoperability with other devices.

1.4 Challenges with IoT in Healthcare

1. Data security and isolation
2. Integration: various devices and protocols
3. Network lifetime
4. Data overload and accuracy
5. Cost

IoT has the potential to revolutionize healthcare by enabling remote monitoring of patients, real-time tracking of vital signs, and improved communication between healthcare providers. However, there are several challenges that need to be addressed in order for IoT to be fully embraced in healthcare.

One major challenge is security. IoT devices in healthcare collect and transmit sensitive personal and medical data, and if these devices are not properly secured, they can be vulnerable to hacking and data breaches. This could compromise patient privacy and lead to serious consequences.

Another challenge is interoperability. IoT devices from different manufacturers may not be able to communicate with each other, making it difficult for healthcare providers to access and analyze data from multiple sources. This can also make it hard to integrate IoT devices with existing healthcare systems.

Another challenge is reliability. IoT devices in healthcare need to be reliable in order to ensure that they are able to provide accurate and timely data when needed. This is especially important for devices that are used to monitor vital signs, as a failure of the device could have serious consequences.

Lastly, cost can be a challenge as well. IoT devices in healthcare can be expensive, and the cost of implementation, maintenance and upgrades can also be high. This can make it difficult for healthcare providers, especially small ones, to adopt IoT technology.

Overall, while IoT has the potential to revolutionize healthcare, it is important to address these challenges in order to ensure that the technology is secure, reliable and accessible to all.

2 Conclusion

To overcome the above mentioned challenges, healthcare organizations need to invest in robust security measures, including encryption, multi-factor authentication, and regular software updates. They also need to focus on standardizing communication protocols and data formats to ensure interoperability between different IoT devices.

In the future, IoT technology will continue to evolve and improve in healthcare. One of the most promising areas is telemedicine, which enables remote monitoring of patients and allows for the collection of large amounts of data that can be analyzed to improve diagnosis and treatment. Another area is the use of wearable devices and sensors to monitor vital signs and detect early signs of disease.

IoT can also be used to improve the efficiency of healthcare systems by automating tasks and reducing the need for manual data entry. This can free up healthcare professionals to focus on providing care and improve the overall patient experience.

In conclusion, IoT in healthcare is a rapidly evolving field with a lot of potential to improve patient care, increase efficiency, and reduce costs. With the right approach and investment, it can help to create a more personalized, effective, and efficient healthcare system.